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(54) Pilot operated valves

(57) A pilot operated valve for a demand valve of breathing apparatus includes a valve body 1, a main valve having an apertured diaphragm main valve member 13 controlling fluid communication between an inlet port and an outlet port 3, a pilot valve 2 including a vent passage 10 sensing downstream pressure to open and close the main valve member as th sensed pressure is above or below a predetermined pressure, and selectively operable latchable override means to suspend pilot operation of the valve by occluding an aperture 39 in a diaphragm 38 in the vent passage 10. By depressing a plunger 40, a saddle 43 is urged by a latch spring 44 against the aperture 39. The latch is released in use by an intake of breath reducing the outlet pressure of the passage 10 displacing the diaphragm 38 and hence the saddle 43 and latch when a spring 41 returns the plunger to its initial position.

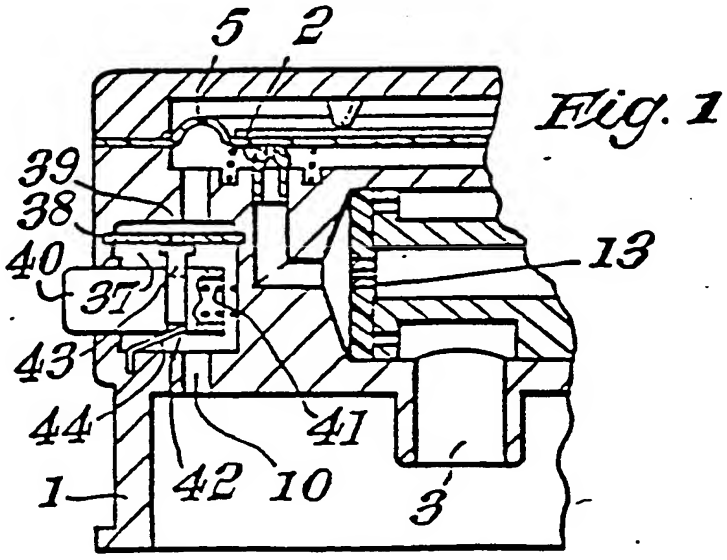

Fig. 1

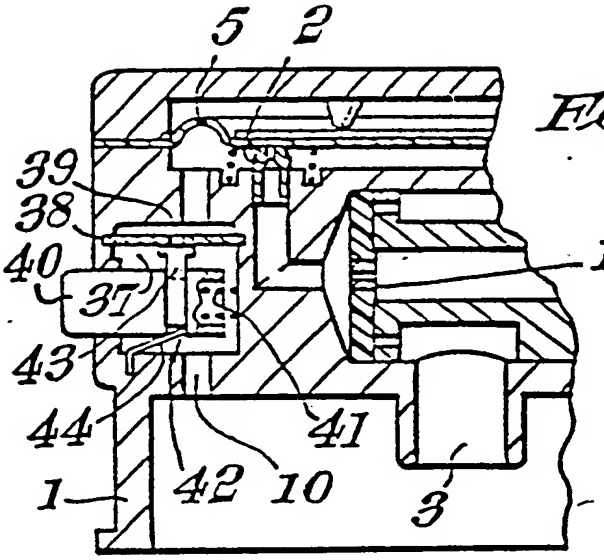

Fig. 1

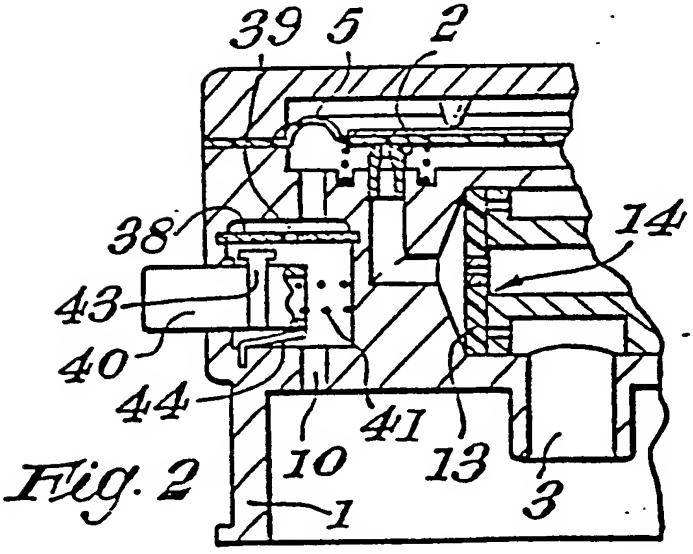

Fig. 2

PILOT OPERATED VALVES

This invention relates to pilot operated valves in general where downstream pressure is sensed and a valve opened or closed in accordance with the sensed pressure. The invention relates particularly to demand valves for breathing apparatus, whereby breathable gas is supplied automatically to the wearer in accordance with his respiratory requirements. A first aspect of the invention is concerned with demand valves of the positive pressure type which continually maintain a pressure within a facepiece or helmet which is slightly greater than that of the surrounding atmosphere, so as to prevent inward leakage.

In such demand valves, flow of gas to the wearer is controlled by movement of a sensitive diaphragm having one face exposed to atmospheric pressure, and the other face to pressure within the facepiece. The present invention provides control means for such valves allowing manual override and automatic shut-off of the supply of gas.

Valves of the Pilot or Two Stage type are sometimes used, wherein mechanical advantage is obtained by gas pressures. Such valves generally employ pivoted levers as a means of transmitting diaphragm movement to the valve, often because the direction of diaphragm movement is inconvenient and has to be reversed.

In known demand valves, the positive pressure is usually established by biassing the diaphragm with a spring.

The present invention relates to improvements in a demand valve described in UK Patent Application No 87.09604 (GB 2,190,001A), the demand valve comprising a housing defining first and second chambers separated by a diaphragm, the first chamber being vented to atmosphere and including fulcrum means to define an eccentric pivot axis for a rigid central part of the diaphragm, the second chamber including a pilot jet facing the diaphragm and closeable thereby at a position on the side of the pivot axis remote from the centroid of the rigid portion of the diaphragm, and a vent passage having an outlet at the outlet of the demand valve, the housing further

defining a third chamber communicating with the pilot jet and partially defined by a valve member adapted to deny access from a high pressure supply port to an outlet port, high pressure being supplied to the third chamber via an orifice, such that while a predetermined back pressure is applied to the outlet of the vent passage, the rigid portion of the diaphragm is held in a position to close the pilot jet and the valve member is held in its closed position by the high pressure supplied to the third chamber via the orifice, and that when the back pressure is reduced the pilot jet is opened, the pressure in the third chamber reduces and the valve member moves to permit access from the supply port to the outlet.

It is advantageous for demand valves of breathing apparatus to be detachable from the facepiece, for procedural and testing purposes. To this end, the invention described in UK Patent Application 87.20095 (GB 2,195,900) provides an automatic shut-off of the demand valve when the demand valve is removed from the facepiece, the pilot operation of the valve being overridden by means of an occluding member operable to block the vent passage and thus maintain the pilot and main valves closed, the occluding member and the facepiece being provided with cooperating abutments which displace the occluding member from its vent-closing position as the demand valve is mounted to the facepiece.

A demand valve of the type first referred to above for mounting to a facepiece of a breathing apparatus includes in accordance with the present invention, an occluding arrangement in which the vent passage is occluded by means sensitive to a reduced downstream pressure and acting to open the vent passage when such a pressure is sensed. In such a device, the vent passage is manually occluded, remaining thus until an inhalation on the commencement of respiration automatically re-opens said passage.

An example of a pilot valve of the invention will now be described in detail with reference to the accompanying drawings, in which:-

Figures 1 and 2 an occluding arrangement for a pilot valve, with the vent passage occluded and open, respectively.

Referring now to Figures 1 and 2, there is provided a pilot operated valve, suitable for use as a demand valve, which is of small size and wherein a diaphragm regulates the flow of gas from a small pilot jet which in turn regulates the flow of gas from a larger jet to a facepiece.

The demand valve comprises a housing 1 which incorporates a pilot jet 2 and an outlet port 3 for connection to a facepiece (not shown). A diaphragm 5 of flexible and resilient material, supported over the greater part of its area by a rigid backing plate 6, is clamped in a leak-tight manner to the housing by a cover 7 secured to the housing 1 by means of screws or a suitable clip arrangement. The cover is vented to atmosphere by one or more ports, and bears two internal projections 9 which act as fulcrum points about which the diaphragm 5 can tilt. A vent passage 10 connects the area under the diaphragm to the interior of the facepiece, by which means not only is pressure within the facepiece transmitted to the diaphragm 5, but also the small flow of gas from the pilot jet 2 when open is freely allowed to escape to the interior of the facepiece.

Movement of the diaphragm 5 towards or away from the pilot jet 2, in response to pressure changes within the facepiece, regulates the escape of gas from a control pressure chamber 11 respectively raising or lowering the pressure in said chamber. This control pressure results from a small flow of gas into the chamber 11 through a metering orifice 12 in a resilient disc 13. The relative proportions of the metering orifice 12 and the pilot jet 2 are so arranged that when the diaphragm 5 is almost touching the pilot jet 2 there will be sufficient pressure in the control chamber 11 to force the resilient disc 13 against the face of main jet 14, obstructing a plurality of ports 15 in said face such that escape of gas from the main jet 14 to the outlet 3 is prevented.

Movement of the diaphragm away from the pilot jet 2 will cause pressure in the control pressure chamber 11 to fall, such that the resilient disc 13 will bow away from the face of the main jet 14 under the influence of gas supply pressure, whereupon gas can escape through the ports 15 thus uncovered and pass to the facepiece via the

outlet port 3. To provide such a demand valve with an override arrangement to cut off the flow of gas until the user's next inhalation, the vent passage 10 passes through a chamber 37 closed at one end by a small resilient diaphragm 38 in which a port 39 permits communication between the vent passage outlet and the area under the main diaphragm 5. A plunger 40 projecting through the wall of the housing 1 and biased outwards by a spring 41 has a circumferential groove 42 in which a forked saddle 43 is free to slide vertically as seen in Figures 6 and 7 up and down. A spring latch 44 engages in the plunger groove 42 when the plunger is pushed into the housing, preventing its outward return.

When thus engaged in the plunger groove 42, the spring latch 44 pushes the saddle 43 upwardly, so that its upper surface touches the diaphragm 38 and occludes the port 39 therein.

Communication between the area under the main diaphragm 5 and the vent passage 10 is thus cut off, and pressure built up under the main diaphragm 5 closes the pilot jet 2 thus closing the main valve 14.

Inhalation creates a marked reduction of pressure within the facepiece, causing the diaphragm 38 to be drawn downwardly, pressing the saddle 43 against the spring latch 44 and disengaging the latter from the groove 42 in the plunger 40. The plunger then moves outwardly under the influence of the spring 41. The saddle 43, being located in the plunger groove 42, moves outwards with the plunger, thus exposing the port 39 in the diaphragm 38 and restoring communication between the vent passage 10 and the area under the main diaphragm 5.

CLAIMS

1. A pilot operated demand valve adapted to be mounted to a facepiece of a breathing apparatus, comprising a housing having an inlet port and an outlet port and a main valve which selectively allows or prevents fluid communication between the inlet and outlet ports, a pilot valve operatively associated with the main valve to cause the main valve to close when the pilot valve is closed, the pilot valve being opened and closed in response to predetermined low and high pressure levels respectively sensed in a pilot valve chamber linked to the outlet port via a vent passage passing through a chamber comprising an entry portion communicating with the pilot valve chamber and an exit portion communicating with the facepiece, a flexible diaphragm extending across the chamber to separate the entry and exit portions and having an aperture to provide fluid communication therebetween, closure means being selectively engageable with the aperture to occlude the vent passage in order to override the pilot operation of the valve, said closure means being resiliently biassed away from its aperture-closing position and being maintained in that position by a latch means, the latch means being releasable by a movement of the flexible diaphragm in the direction towards the exit portion of the chamber.

2. A demand valve according to Claim 1, wherein the closure means comprises a first sliding member mounted to the housing for movement in a plane parallel to that of the flexible diaphragm and a second sliding member carried by the first sliding member for movement in directions perpendicular to the plane of the flexible diaphragm, latch means engaging the first sliding member in the aperture-closing position being released by movement of the second sliding member in a direction away from the flexible diaphragm.

3. A demand valve substantially as described herein and illustrated in Figures 1 and 2 of the accompanying drawings.

Amendments to the claims have been filed as follows

1. A pilot operated demand valve adapted to be mounted to a facepiece of a breathing apparatus, comprising a housing having an inlet port and an outlet port and a main valve which selectively allows or prevents fluid communication between the inlet and outlet ports, a pilot valve operatively associated with the main valve to cause the main valve to close when the pilot valve is closed, the pilot valve being opened and closed in response to predetermined low and high pressure levels respectively sensed in a pilot valve chamber linked to the outlet port via a vent passage passing through a chamber comprising an entry portion communicating with the pilot valve chamber and an exit portion communicating in use with the facepiece, a flexible diaphragm extending across the chamber to separate the entry and exit portions and having an aperture to provide fluid communication therebetween, closure means being selectively engageable with the aperture to occlude the vent passage in order to override the pilot operation of the valve, said closure means being resiliently biassed away from its aperture-closing position and being maintained in that position by a latch means, the latch means being releasable by a movement of the flexible diaphragm in the direction towards the exit portion of the chamber.

2. A demand valve according to Claim 1, wherein the closure means comprises a first sliding member mounted to the housing for movement in a direction parallel to the plane of the flexible diaphragm and a second sliding member carried by the first sliding member for movement in directions perpendicular to the plane of the flexible diaphragm, latch means engaging the first sliding member in the aperture-closing position being released by movement of the second sliding member in a direction away from the flexible diaphragm.

3. A demand valve substantially as described herein and illustrated in Figures 1 and 2 of the accompanying drawings.

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